Chapter Highlights

- Capital consists of money, buildings, property, equipment, and all the other goods a business may own.
- Companies can raise capital by making bank loans, selling stock, or using their own funds.
- Profit is the money left over after all the company's expenses have been paid.
- Time influences the way products are made, how much they cost, and how people use them.

Test Your Knowledge

1. List the types of capital that might be owned by a large farm.
2. List three sources of capital a company might use to finance expansion.
3. What is interest?
4. Why might stockholders not receive any dividends from a company in which they hold stock?
5. What do you call the money left after your company deducts expenses?
6. If your company had poor cash flow, should you be concerned? Explain.
7. Give two examples of why, in technology, "time is money."
8. List three products that have expiration dates.
9. Explain one method used in technology to speed up production.
10. List three seasonal items. When would be the best time to purchase each item?

Correlations

SCIENCE

1. Milk has a "sell by" date stamped on the carton. Open a container of milk on this "sell by" date and pour some milk into seven small containers. Put an airtight cover on each and refrigerate. Check one container each day for a week. Did any of the milk spoil? When?

MATH

1. Suppose you borrow $3500 from a bank at 6% interest. How much money will you owe the bank at the end of one year? Use the formula Interest = Principal \times Rate \times Time.

LANGUAGE ARTS

1. Think about the phrase "time is money." In a paragraph, give your own explanation of this phrase.

SOCIAL STUDIES

1. Where did Henry Ford get the idea for assembly line production? Find out how he set it up in his car production plant. How fast could Ford's workers manufacture a car? What did this do to the price of cars?
Introduction .................................

The word *system* is used often in technology. What is a system? Can you name some everyday systems?

You may have seen the word *system* used to describe machines. You may even have some small systems at home. Computer systems and stereo systems are found in many homes today. Have you ever seen an advertisement in a newspaper for an intruder alarm system or low-cost heating system?

You may watch a TV news broadcast covering a debate over the proposed construction of a solid waste disposal system in your community. Each day, you may travel along a complex highway system on your way to school.

Systems—thousands of them—are all around us. Some are gigantic, like our nation’s highway system. Some systems are as small as a home computer system. The purpose of this chapter is to help you understand how systems are used in technology to combine resources.

After reading this chapter, you should be able to .................................

Define and give examples of systems in technology.

Explain the similarities among systems.

Diagram simple systems.

Separate large systems into smaller subsystems.

Discuss the impacts of systems.

Words you will need ............................

- system
- input
- process section
- output
- system diagram
- feedback
- subsystems
What Is a System?

A system is a group of parts working together to achieve a goal. Let’s look at a common system: a ten-speed bicycle. When you use a ten-speed, what result do you hope to get? What goal do you want to achieve? You probably want to move fast or climb a hill with the least amount of effort provided by you, the rider. Fig. 9-1.

A ten-speed bicycle is a system designed to increase the amount of speed and force your legs provide to the wheels. This system enables you to travel faster and climb hills easier.

Large or small, systems help satisfy our needs and wants by doing work for us. Systems can help us to achieve desired outcomes. Figure 9-2 shows some other common systems and their outcomes.

Fig. 9-1. Systems are designed to help people achieve a goal by producing a desired outcome.

Goal = To find the solution to a multiplication problem: 5 x 2.

Goal = To travel up the hill in the fastest time possible with the least amount of energy.

Fig. 9-2. The needs and wants of people determine the goals they have for the systems they use.

TECHNOLOGY TRIVIA

Road construction was one of the great triumphs of the Roman Empire. By the time the empire fell in the 5th century A.D., its road system included more than 50,000 miles of roads in Europe and the Middle East. Some of these can still be seen today.
FOR DISCUSSION

1. You have just learned what a technological system is. We are also surrounded by natural systems, such as our solar system. List at least three other natural systems.

2. What are the desired results of a large, well-designed transportation system?

How Do Systems Work?

All systems, large and small, have many things in common. For a system to provide a desired result, it must be able to accept commands from the people using it. This is called input. A ten-speed bicycle uses gearshift levers and pedals to input commands from the rider. Fig. 9–3. Input commands tell the system what to do. Figure 9–4 shows some ways in which people input commands into a system.

Fig. 9-3. The rider gives the bicycle a command (input) by pulling or pushing on the gearshift levers. The sprocket reacts by moving the chain to a different gear combination.

Fig. 9-4. People input or give commands to systems in many different ways every day.
The part of the system that does the actual work and achieves the desired result is called the process section. The gears on a ten-speed bicycle make up the process section of that system. By selecting different combinations of gears, the rider can increase the speed of the bicycle and force applied to the wheels. Fig. 9-5.

The process section of a system achieves its goal by combining the seven resources of technology. Figure 9-6 shows how a ten-speed bicycle combines the seven resources of technology to provide the desired result.

Fig. 9-6. The process section of any system combines the seven resources of technology to achieve a desired outcome.
The actual result produced by the process section of a system is called the output. If the system is working correctly, the output should be exactly what we expect. What should the output of a ten-speed bicycle be?

**Diagramming Systems**

System diagrams, or charts, make it easier to understand how a complex system works. Fig. 9–7. Figure 9–8 shows a block diagram of a ten-speed bicycle. The diagram shows the relationship between the input, process, and output sections of a system.

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**Fig. 9-7.** A system diagram is a chart that shows how the three basic sections of a system work together to achieve a desired result.

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**Fig. 9-8.** Example of a system diagram for a ten-speed bicycle.

**Input (Command)**

Travel up the hill with the least effort.

**Output**

Rider reaches hilltop with least amount of energy exerted.
Feedback

Suppose your goal is to travel 20 miles per hour on your bicycle. How do you know when you have accomplished your goal? You might install a speedometer on your bike. The speedometer would show you your traveling speed. In technology, we call this feedback.

Feedback is information about the output of a system. Many systems use feedback to monitor how a system is working. When we know how a system is working, we can adjust the system to help reach our goal.

If the speedometer tells us we are traveling at 22 miles per hour, we can adjust the system by pedaling slower or changing gears. Figure 9–9 shows how we add the feedback loop into our block diagram.

Many systems must be monitored and adjusted by people. Other systems are automatic—they monitor and adjust themselves. Fig. 9–10.

FOR DISCUSSION

1. Make a list of the technical systems, large and small, found in your school.
2. Draw system diagrams for two of the above systems.
Fig. 9-10. The heating system that keeps your house warm is an automatic system. The thermostat monitors room temperature and turns the furnace on and off as needed.
**Systems and Subsystems**

Systems may be made up of smaller systems called **subsystems**. How many subsystems are in a ten-speed bicycle? The handlebars and fork make up the guidance subsystem. The pedals and gears make up the power subsystem, and the tires make up the suspension subsystem. Can you think of any other subsystems?

Both large and small systems can be broken down into smaller subsystems. Breaking systems down into subsystems makes it easier to study them. Fig. 9-11.

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Fig. 9-11. Most systems can be broken down into smaller subsystems.

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**FOR DISCUSSION**

1. Your home is a very complex technical system. List at least four subsystems found in your home.
2. Systems become more powerful when we expand them by adding additional subsystems. What subsystems can we add to a computer system to make it more powerful?
System Output

In Chapter 1, we learned that the four families of technology (communication, transportation, production, and biotechnology) provide us with the products and services we use each day. The four families of technology can be considered systems. The products and services we use are part of the output of these systems.

Systems usually have more than one output. For example, the main output of a paper mill is paper. A secondary output of the mill may be wood chips and sawdust. Some mills turn these chips into pellets that can be burned to produce electricity.

The outputs of a system are not always desirable. The same system that produces paper and pellets may also produce air pollution and terrible smells. When people design systems, they must be aware of the undesirable outputs of the systems.

FOR DISCUSSION

1. A new coal-fired power plant has been built in your community. List two desirable and two undesirable outputs of that system.
2. List two outputs for each of the four families of technology.

Extension Activity

- Make a diagram showing the inputs, processes, and outputs involved in planning and building a model community.

- Do research on recycling procedures. Then write a report on the system used to recycle a product such as a newspaper.
Chapter Highlights

- Systems are designed to produce desired outputs to help people meet their wants and needs.
- All systems are similar in that they all have input, process, and output sections.
- The process section of a system combines the seven resources of technology.
- A system diagram charts how a system works.
- Subsystems are smaller systems within a larger system.
- Systems can have multiple outputs.

Test Your Knowledge

1. What is a system?
2. When you use a calculator, what is your desired result?
3. What three parts do all systems have in common?
4. What part of a system combines the seven resources of technology?
5. What does the feedback loop do in a system?
6. Draw a system diagram to explain how a washing machine works.
7. What is a subsystem?
8. List the subsystems found in a home stereo system.
9. What are the four systems that provide all the products and services we use each day?
10. List one positive and one negative output of an automobile.

Correlations

SCIENCE

1. Consult a biology textbook to identify three of the systems in the human body. List the parts for one of those systems.

MATH

1. If you travel 20 mph (miles per hour) on your ten-speed bike, how long will it take to go 5 miles? 10 miles? You increase your speed to 22 mph. Will it take you more or less time to go the same distance?

LANGUAGE ARTS

1. Brainstorm and list as many systems as you can. Compare your list with your classmates’ lists and make a final copy of all the systems named to display in the classroom.

SOCIAL STUDIES

1. Long before the construction of its vast highway system, the United States established an extensive railroad transportation system. On a map of the United States, diagram the states connected by the first railroad transportation system.
2. List the inputs, processes, and outputs of a transportation system.
From conducting recycling projects to planting trees—from creating environmental awareness to helping save endangered animals—young people have been using their talents to improve their world.

By participating in the President’s Environmental Youth Awards Program, students in grades kindergarten through 12 have created projects to promote community involvement with important environmental issues.

Since 1986, when the U.S. Environmental Protection Agency began sponsoring an annual national environmental competition, thousands of successful projects have been launched by students from throughout the nation.

At River Trails Junior High School, a teacher and her students launched a “grassroots” environmental action group, Project P.E.O.P.L.E. (People Educating Other People for a Long-lasting Environment). The students prepared a booklet outlining 80 ways that each person can reduce pollution and improve the environment. They encouraged individuals, schools, and businesses to join the organization and to pledge to do as many things on the list as possible. Project P.E.O.P.L.E. soon grew to more than 600 members in nine states, England, and Japan.

In Texas, a high school student started a three-city recycling program—and during a one-week pilot project, residents and students recycled seven tons of newspapers and 300 pounds of aluminum cans. Proceeds from the project were then donated to the three cities to begin a permanent recycling program.
Through a letter-writing campaign, students at a Utah elementary school started a “Leaf It to Us” Crusade for Trees. They raised funds, received two small grants, planted 182 trees on public lands—and encouraged students across the state to do the same. The students also worked with the state legislature to pass a bill to create many more grants for planting trees.

While he was a junior high student, Eric Champlin chose barn owls for a science-fair project. Hoping to increase their population, he built and placed nesting boxes in suitable barns throughout Ohio—and included tapes for attracting owls.

In still another project, students at Crosby-Ironton High School cleaned up an abandoned mine pit to make it suitable for swimming, fishing, and boating.

A group of Indianhead Council Boy Scouts traveled to Costa Rica on still another project—to help save the endangered leatherback sea turtle. The Scouts gathered information, discouraged turtle-egg poachers, and planted trees to prevent soil erosion. They helped cut the loss of turtle eggs from 85 percent to 5 percent.

In a “Save the Rain Forest” project, a student-teacher group from Dodgeville High School enlisted 9,000 schools in their cause and raised more than $150,000 for rain forests throughout the world.

Students throughout the country have also worked on a wide variety of other projects—from improving water quality in lakes, to turning a vacant lot into a “garden” classroom, to starting a recycling business—and all with one goal: to improve and protect the environment.
No one can do everything. Disabilities exist in different forms and in varying degrees of seriousness in all people. Serious disabilities, such as not being able to walk, are often referred to as handicaps. Today, advances in technology are freeing more and more people from limitations resulting from physical handicaps. While it’s true that “no one can do everything,” it’s also true that practically everyone can do something and most can do a lot of things. Devices can be developed to use what a person is capable of doing to accomplish things that he or she is otherwise unable or finds difficult to do.

In order to develop a device to aid a handicapped person, several technical problems must be solved. As you do this activity and as you read Chapters 10 and 11, you’ll learn for yourself how the resources of technology can be used to solve all sorts of technical problems.
PART 2: Your Challenge

Your challenge in this activity will be to invent a device that will aid a person with a physical handicap. Figs. III-1 through III-3 show some examples. Your invention can be:

- intended to aid any type of physical handicap. (Examples—limitations in body motion or senses)
- a modification of an existing device. (Example—wheelchair modification)
- a totally new concept. (Example—a new device unlike any other invention)
- a working prototype of a real device. (Example—an invention that really works, such as a special fork or spoon)
- a simulated model. (Example—a cardboard model of a special house design equipped with special devices)

Fig. III-1. House dusting device for people confined to a wheelchair.

Fig. III-2. Special wristband to help hold eating utensils.
PART 3: Specifications and Limits

Your invention will need to meet certain standards. Read the following specifications and limits carefully before you begin.

1. Your invention must:
   - be a working device or a non-working model
   - help a person with a physical handicap
   - be safe
   - be documented (supported in writing) with a technical report and drawings

2. Your design team is responsible for:
   - development of the invention
   - writing a technical report
   - preparing a set of drawings
   - giving a presentation to the class describing the operation of the invention and how it helps people

Fig. III-3. Model of a house design for a wheelchair-bound resident.
**PART 4: Materials**

Any material safe to use and inexpensive can be used to build your device or model. To the left is a list of possibilities. Also given is a list of tools you might use.

**Materials**
- cardboard
- paper
- string
- wood
- wood dowels
- wire
- plastic
- glue
- fasteners
- metal
- rubber bands
- motors
- large syringes and tubing

**Tools**
- utility knife
- scissors
- power tools
- screwdrivers
- wrenches
- hot glue gun

**Safety Notes**
- Consider always the safety of the people who would use the device you invent.
- As you do this activity, remember to follow all the safety guidelines your teacher has explained to you.
- Use all tools properly. Use special care with tools that are sharp.
- Before using any power tools, be sure you understand how to operate them and always get your teacher's permission.
Your invention and how you build it will be up to you. Still, there are certain steps to follow that will make your work easier.

1. Working in groups of 2 or 3 students each, brainstorm possible ideas for devices to aid the handicapped. Then evaluate your ideas and exclude those that are too complicated, expensive, or unsafe.

2. Draw sketches of promising ideas to be sure all members of the team understand what the inventions would be.

3. Do research on devices for the handicapped to find out what has already been done.

4. Interview someone with a physical handicap to share ideas about possible products. Take written notes or, with permission from the person you are interviewing, make an audio or video recording of the interview. Share your interview with the class.

5. What do you hope to achieve? Review possible designs and select what you think is your best idea for an invention.


7. Cut and fasten materials together to form a rough design. Continue testing and making improvements until you achieve your final design.

8. Create technical drawings of your invention. Describe the whole design and important parts or features (details) using orthographic projection.

9. Write a technical report describing how your design team developed the invention.

10. Prepare and deliver a short presentation to the class describing your invention and the design problems you solved during its development. Demonstrate how your device can be used.